

are neither synchronous nor homologous with those of the chromatophore. The cause of the active movement of the chromatophore resides exclusively in the radial fibres. This is directly demonstrable by means of a crucial experiment.

If we completely destroy the centre of a chromatophore with a needle, so as to leave only the periphery intact, the movements of expansion and contraction continue to take place in this intact portion. If, on the other hand, we destroy the radial fibres by a circular lesion, leaving the cell intact, the movements are completely abolished. It is, on the contrary, the central or coloured portion of the chromatophore which, by the influence of its elasticity, exercises the active rôle in the stage of contraction. This elasticity is easily displayed; a gentle pressure on the centre of a chromatophore is sufficient to flatten it and spread it out; but as soon as the pressure is removed the organ resumes its spherical shape.

To sum up our results: the chromatophore of the Cephalopods is an elastic pigmented sphere, the expansive movements of which are determined by the contraction of muscles arranged radially at its equator, and which reverts to the spherical shape as soon as the contraction has ceased.—*Comptes Rendus*, t. exiii. no. 16 (Oct. 19, 1891), pp. 510–512.

*On the Anatomy of the Male Sexual Organs of the Honey-Bee.*

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In my investigations into the structure of the male sexual apparatus of the honey-bee I arrived at the following results.

All existing figures and descriptions of the male sexual apparatus of the honey-bee in zoological and apicultural literature are either incomplete or incorrect. The testis of the bee has two envelopes. The external one, formed by the fat-body, has two kinds of cells—(1) large and flat, with elongated flattened nuclei; (2) irregularly spherical, which are entirely similar to the cells of the fat-body containing fat-globules. The second inner envelope is of the nature of connective tissue, and two layers are to be distinguished in it. In the outer layer we find large cells with oval nuclei, and the inner layer is finely fibrillar, with spindle-shaped nuclei.

The seminal tubules are surrounded by a delicate fibrillar envelope, containing elongated nuclei, and open into a reservoir in the interior of the testis, which is clothed with epithelium. This epithelium enters slightly into the orifice of each separate seminal tubule.

The tracheæ, which everywhere penetrate the testicular envelopes, ramify in the interior of the testis between the several seminal tubules. The belief (Cholodkowsky) that in butterflies there are no tracheæ within the testis is erroneous.

The entire testis of the bee corresponds to only a section of the testis of such a type as, *e. g.*, in *Bombyx mori*. The reservoir, into which all seminal tubules open, is enveloped in a thick membrane

of connective tissue containing oval nuclei. From the reservoir the vas deferens is separated off, the epithelial cells and nuclei of which are larger than those of the reservoir. The vas deferens runs for a time within the testis, forms loops there, and, after issuing therefrom, makes several loops, rolling itself into a little ball, and then passes into the seminal vesicle.

The epithelial cells of the seminal vesicle (*vesicula seminalis*) are very columnar and ranged in annular cylinders ("Ringwalzen"). These cells are of a glandular nature. On the outer side of the epithelium lies an extraordinarily thin connective-tissue membrane, and then follows a muscular layer, which we do not find upon the vas deferens. The deep-lying layer consists of circular and the upper layer of longitudinal muscles. In addition to the closely adhering thin connective-tissue membrane, which envelops the entire vas deferens and the seminal vesicles, these two organs have a special membrane, which is not closely adhering and is a prolongation of the testicular membrane. This membrane completely conceals the vasa deferentia.

The seminal vesicle narrows into a bow-shaped canal, which opens not into the ductus ejaculatorius, but into the glandulæ mucosæ. The epithelial cells, which clothe this canal, are very highly vacuolate, so that they have a spongy appearance. Blind tubes which are described by R. Leuckart\* as appendages of the glandulæ mucosæ, and figured in his chart ('Anatomie der Biene'), are nothing else than severed muscles which are attached to the wall of the abdomen, and were described by Swammerdam.

The glandulæ mucosæ have, beneath a thin membrane of connective tissue, a layer of longitudinal muscles; under this is a layer of circular muscles, and then, in addition, we have three groups of deeply-lying longitudinal muscles, which are only developed in that portion of the organ which is nearer the ductus ejaculatorius. These longitudinal muscles press the epithelial layer of the mucous glands into three longitudinal folds. Towards the other end of the mucous gland the deep-lying muscles grow continually narrower, until they finally disappear altogether. Beneath the muscular layer lies a structureless membrane of connective tissue, and then a layer of narrow, columnar, glandular epithelial cells, with oval nuclei.

The ductus ejaculatorius is inserted by means of two chitinous branches into the junction of the two glandulæ mucosæ. This paired portion of the ductus ejaculatorius is completely hidden beneath the muscular layer of the glandulæ mucosæ. The ductus ejaculatorius, as well as the entire copulatory apparatus, is devoid of muscles. (In Girard† and Cheshire‡ we find it incorrectly stated that the ductus ejaculatorius has a strong musculature.) Beneath the very thin membrane of the ductus ejaculatorius lie

\* R. Leuckart, 'Die Anatomie der Biene:' Cassel und Berlin, 1885, p. 13.

† M. Girard, 'Les Abeilles:' Paris, 1885.

‡ Cheshire, 'Bees and Bee-Keeping:' London, 1887.

flattish epithelial cells, and then a thicker, transparent, elastic, and very extensile chitinous layer.

From the end of the ductus ejaculatorius to the external opening of the sexual apparatus we have an uninterrupted chitinous sac, with various kinds of evaginations, folds, and thickenings. The upper portion of this section of the sexual apparatus, termed the "bulb" by Leuckart, is laterally compressed, and has beneath a delicate external membrane very columnar epithelial cells, beneath which there lies a tolerably thick layer of transparent colourless chitin, upon which on each side two large chitinous plates, which are fused together, are fixed. The chitin of these plates has a distinctly granular structure, and the clearer and softer the chitin, the more plainly are the granules visible. In the completely hardened places the granules cannot be seen at all, or only indistinctly.

The portion of the genital sac which follows the bulb of the penis is so strongly chitinized that nothing is to be seen of the epithelial cells. The chitin is thickly covered with stout simple (not branched) hairs, directed inwards, which are larger and thicker at those spots where there are evaginations and folds in the chitinous wall. These structures have, as everyone is aware, a mechanical importance in the act of coition, and have been described a thousand times, but never quite correctly. The exact description of these structures is out of place in a provisional communication, since too many details would have to be alluded to. I will only observe that, with the exception of the above-mentioned chitinous plates of the bulb of the penis, we find no plates in the entire genital sac of the bee, but only evaginations and folds of the chitinous wall.

The detailed description of the genital apparatus will appear in the 'Tageblatt der zoologischen Abtheilung der kais. Gesell. d. Naturw. Anthropologie und Ethnographie.'—*Zoologischer Anzeiger*, xiv. Jahrg., 1891, no. 376, pp. 393-396.

*On the "Free-swimming Sporocysts."* By M. BRAUN,  
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The term "free-swimming sporocyst" has been applied by E. Ramsay Wright\* and R. Leuckart† to the single example which has hitherto been discovered of a certain developmental stage of a *Distomum*. I have observed numerous specimens in an aquarium in which I had shortly before placed various freshwater snails from the "bog" ("Bruch") near Rossitten in the Kurischer Lowlands. While, however, the American species is only 1 millim. in length, the specimens from this locality are as much as 6 millim. long, and

\* 'American Naturalist,' vol. xix. 1885, pp. 310, 311.

† Die thierischen Parasiten des Menschen &c., 2 Aufl. 2 Bd. pp. 102, 103.